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NPG Report No. 1283

RAPID FIRE LIFE TEST OF 3"/70 CALIBER GUN BARREL TYPE C MOD 2 SERIAL 24583 WITH COOL NON-PICRITE POWDER

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

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Date: 21 July 1954

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U. S. Naval Proving Ground
Dahlgren, Virginia

Rapid Fire Life Test of

3"/70 Caliber Gun Barrel Type C Mod 2 Serial 24583

With Cool Non-Picrite Powder

by

M. L. Hunt
Armament Department

NPG REPORT NO. 1283

Task Assignment No.
NPG-Re5a-21-1-53

21 July 1954

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CONFIDENTIAL

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ABSTRACT

A rapid fire life test has been conducted in 3"/70 caliber gun Type C Mod 2 Serial No. 24483 employing a cool double base picrite propellant. The results of this test were reported in reference (c). The Bureau of Ordnance has directed that a similar test in a similar barrel employing a cool single base non-picrite propellant be conducted in order to establish the relative erosion rate for the two propellants. 3"/70 Caliber gun Type C Mod 2 Serial No. 24583 was used in this latter test.

The planned firing program consisted of five 15-round bursts with five second interval between bursts. The rate of fire was to be 90 rounds per minute. Barrel No. 24583 was fired a total of 957 rounds. At that time asymmetric forward bore wear had developed to such an extent that further firing was not deemed advisable.

The wear rate near the origin of bore with cool non-picrite powder closely approximates that with cool picrite powder. The forward bore wear in barrel No. 24583 (fired with cool non-picrite powder) was much more severe than in barrel No. 24483 (fired with cool picrite powder). The cause of the disparity in forward bore wear cannot be resolved at this time. Conceivably the propellant composition could be a contributing factor. Metallurgically one barrel may differ from another sufficiently to cause considerable variations in barrel wear. In both barrels forward bore wear was more severe than has been experienced in the 3"/70 Caliber Gun Type G Mod 7 under single fire conditions.

FOREWORD

The work described in this report was conducted between 22 April 1952 and 10 September 1953, under Task Assignment NPG-Re5a-21-1-53 "3"/70 Caliber Gun Barrels" (reference (a)) and was specifically authorized by reference (b). This is the 69th partial report on the basic task assignment and the final report on Test of 3"/70 Caliber Gun Type C Mod 2 Serial 24583.

The tests upon which this report is based were conducted by R. V. Collins, Lieutenant (jg), to whom full credit is due for completion of firing in a short period of time in spite of repeated mount failures and for the maintenance of uniform test conditions within the limits imposed by material and test equipment.

This report was reviewed by:

S. E. HEDDEN, Acting Head Interior Ballistics Division
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INTRODUCTION

In the propellant research program for the 3"/70 caliber gun the Bureau of Ordnance has developed a cool double-base, picrite propellant with a satisfactorily small erosion rate, but for logistic reasons a similarly cool, single base, non-picrite propellant has been developed. The Bureau of Ordnance requested that erosion trials be conducted with this latter propellant for comparison with results obtained from trials with the cool picrite propellant.

In addition to wear rate determination it was desired to obtain velocity and range data under rapid fire conditions and to compare slow fire and rapid fire range dispersion.

DESCRIPTION OF ITEM UNDER TEST

Gun Barrel

The 3"/70 caliber barrel Type C Mod 2 is of monobloc construction. The chamber and bore are plated with 0.0006 of chromium. The rifling has constant twist of one turn in 25 calibers and tapers to a smooth bore 9.976 aft of the muzzle. The barrel is cooled by means of water pumped through an external jacket at the rate of approximately 92 gallons per minute.

Propellant

Propellant IX-94 is a cool composition (1980°K flame temperature) with the following characteristics:

Nitrocellulose (11.92% N)	89.00%
Centralite	6.03%
$PbCO_3$	1.11%
Total Volatiles	3.86%
Length	0.394
Diameter	0.198
Web	0.038
Perforations	7
R. Q.	97.9 (Ex 6586)
R. F.	98.7 (Ex 6586)

Assembled Round

Projectile:	Ex 11 (15.00 lbs) Epsom Salts loaded
Case:	Ex 3 (Steel) (Rubber Crimped)
Primer:	Mk 46
Gauges:	3 1/30 - Area (Erosion check rounds only)
Powder:	IX-94 - 8.79 lbs
Lead Foil:	None
PPD:	Full Case (Wad)

Mount

The 3"/70 caliber mount Mk 35 Mod 0 used during this test has a cyclic rate of 90 rounds per minute. The rate of fire maintained during the subject test was approximately 80 rounds per minute.

DESCRIPTION OF TEST EQUIPMENT

Muzzle velocities were measured by means of a single pair of solenoids and a counter chronograph. The location of the solenoids with respect to the gun muzzle and the distance between solenoids fell into two main categories:

a. Rounds 1 through 592:
   Muzzle distance - 59 1/6
   Distance between solenoids - 35 1/6

b. Rounds 593 through 957:
   Muzzle distance - 62 1/0
   Distance between solenoids - 31 1/6

Maximum chamber pressure on the erosion check rounds was determined from three 1/30 area copper crusher gauges.

Ranges were measured on the erosion check rounds by visual bearings from three shore stations. Attempts were made, with some success, to measure ranges of rapid fire rounds photographically in order to compare rapid and single fire range dispersion.

PROCEDURE

It was desired to conduct the rapid fire tests by firing a series of 75-round sequences, each sequence to consist of five 15-round bursts with a five second interval between bursts. The barrel was to be completely cooled between sequences. The planned rate of fire was 90 rounds per minute. Frequent casualties in the operation of the automatic loader prevented completion of many of the scheduled 75-round sequences. The rate of fire fell somewhat below the designed level, but at no time was it below 76 rounds per minute and the average was 80 rounds per minute. Figure 8 of Appendix (C) indicates the burst lengths and total rounds of each sequence.

The barrel was bore-searched and star-gauged at frequent intervals and was shipped to the Naval Gun Factory for bore photographing and decoppering after 156, 234, 478 and 957 rounds had been fired.

A cold-gun single-fire erosion check was fired after each 75-round sequence or as closely thereto as possible. Those rounds were carefully assembled and temperature conditioned at 90°F on all occasions. Chamber pressure, muzzle velocity, and range were recorded for each round.

Rapid fire tests were carried out until asymmetric bore wear had reached such an advanced stage that both muzzle velocity and projectile flight were very erratic. A sufficient number of rounds was fired to remove the plating in the vicinity of the origin of bore and to establish the initial erosion rate.

Cooling water was pumped through the water jacket at a rate of approximately 92 gallons per minute. Casualties to the water cooling system prevented continuous water cooling on all programs.

RESULTS AND DISCUSSION

The barrel under consideration was fired for 957 rounds in all, 761 rounds in rapid fire and 196 rounds single fire.

Erosion Data

Figure 1 of Appendix (A) is a plot of bore enlargement at the origin vs rounds fired for barrel No. 24583 with a similar curve for barrel No. 24483 included for reference purposes. Referring to the curve for the latter barrel, it is seen that the origin of bore diameter very quickly enlarged by approximately 0".014. This enlargement is believed due to swaging of the lands. It is noted that barrel No. 24583 maintained its original diameter for approximately 600 rounds. This may indicate different characteristics between the metal of the two barrels. After plate removal the wear rates for the picrite and non-picrite propellants are 0".00010 and 0".00008. The relatively small number of rounds fired in barrel 24583 after plate removal permits the establishment of a wear rate which must be considered tentative. The many mount difficulties which made it almost impossible to control burst length and pause duration between bursts as well as deviations in rate of fire are unfortunate aspects of this test. Certainly no difference can be detected between the two powders in relation to erosion rate at this stage.

Figure 2 of Appendix (A) shows profiles of erosion from 10" aft to 12" forward of the origin of bore for the two barrels under consideration. At comparable round numbers the erosion in barrel 24583 is restricted to a much shorter region of the bore than in barrel 24483. This may be due to the barrel-to-barrel difference (better plate adhesion) as well as the powder difference. However, similar erosion trials carried out in 3"/50 caliber rapid fire barrels showed a similar decreased volume of erosion for cool non-picrite over cool picrite powder.

Figures 3 and 4 of Appendix (A) show forward bore wear in barrels 24583 and 24483 respectively. These plots portray the serious nature of this type of wear in 3"/70 caliber barrels. The groove depths, which were obtained by taking one half the difference between groove and land diameters, are not realistic portrayals of the true bore condition due to the impossibility of gauging groove to groove diameters accurately when the gun bore is severely worn. However, these plots do give some knowledge of effective rifling remaining at various stages of this test. The cause of the excess of forward bore wear in barrel 24583 over that in barrel 24483 is unknown. There is a strong temptation to attribute this difference in wear to barrel-to-barrel variation and the contrasting behavior of the two barrels in the vicinity of the origin of bore in their early lives would tend to indicate different metal characteristics. However, the forward bore wear in barrel 24583 exceeds that obtained in any other barrel fired at the U. S. Naval Proving Ground. Figure 5 of Appendix (A) is a plot of maximum forward bore wear versus rounds fired for the two guns under consideration and in addition for a Type G Mod 1 and a Type G Mod 7 barrel. The particular Type G Mod 1 gun was chosen because the firing in this barrel was quite severe with a fairly large number of rounds at proof pressure. The maximum forward bore wear, even so, was less than in barrel 24583. The Type G Mod 7 barrel (1/20 twist) was chosen because it is representative of this type under slow fire conditions.

Pressure time curves for the cool non-picrite powder were smoother and ejection times were approximately 3 milliseconds longer than for the cool picrite. Representative P-T curves for each powder type are shown on Figures 6 and 7 of Appendix (B). It is noted that the peak pressure for IX-94 occurs later in the interior ballistic trajectory than it does for Ex 6586. It is possible that this factor has a bearing on the difference in forward bore wear obtained with the two powders. Unfortunately these P-T curves represent firing in a small chamber gun in the case of the picrite powder and in a large chamber gun in the case of the non-picrite powder. However, since they represent the only pressure-time histories available for these powders they are presented for what they are worth.

Velocity Data

Figure 8 of Appendix (C) is a round by round plot of velocity versus round number. A number of wild rounds occurred for which no explanation is available. Table 1 of Appendix (B) is a tabulation of velocity variance for erosion-check single-fire groups and for rapid fire rounds of a shoot. Variances are computed for both gun number 24483 and 24583. Since trends in velocity are apparent in some series of rounds the following method was used in computing variance:

$$Si_2 = \frac{\Sigma_k \ (V_k - V_{k+1})^2}{2 \ (n-1)}$$

The table shows variances for all rounds and variances after eliminating certain rounds whose velocities fell beyond three standard deviations from the mean of the group. Forty-two rounds were eliminated for barrel 24483 and 40 rounds for barrel 24583. The variances for the two barrels cannot be compared statistically since the velocity variances from barrel 24483 appear to come from two distinct populations. Standard deviations are also listed for appropriate groups from each barrel. Extensive firing programs in 3"/70 caliber large chamber guns, with all known variables carefully controlled, indicate a standard deviation of 10 f/s for single fire velocities with cool picrite powders. After eliminating the statistically wild rounds referred to above the standard deviations with cool non-picrite powder compare more favorably with the 10 f/s standard deviation for single fire large chamber guns than do those from barrel 24483 with cool picrite powder. It is quite possible that part of the velocity variation is due to measurement error resulting from the short base line and movement of the near solenoid tower caused by muzzle blast. (The distances from gun muzzle to near tower and between towers were as great as possible for the required gun elevation and tower heights.) Severe forward bore wear also appears to have an adverse effect on velocity uniformity.

Figure 9 of Appendix (C) is a plot of 5-round mean velocities versus round number. Figures 10, 11, 12 and 13 of Appendix (C) are plots of velocity loss versus bore enlargement at origin, erosion gauge reading, rounds fired and bore enlargement at origin plus maximum forward bore enlargement respectively. The data obtained from the tests under consideration indicate that conventional methods cannot be used to predict velocity loss for the two powder types with a single velocity loss table.

There are a number of factors which make evaluation of the velocity loss performance of the two guns of dubious value. There has not been a master standard powder for the 3"/70 caliber gun and as a result charge assignments must be made by the new gun method. Under this condition the velocity level at which each powder is being assessed is not accurately known. The charge assignment for Ex 6586 was made with a P.P.D. assembly using wads and spacers. The P.P.D. used in the charge assignment was 3⅞1. During the course of the erosion checks this value varied from 3⅞1 to 3⅞5 and on some occasions the powder was assembled loosely to give a full case. Ex 6827 and IX-94 were assembled uniformly with a loose full-case packing. The severe forward bore wear in both barrels probably has an unpredictable round to round effect on velocity.

Powder temperature on rapid fire rounds was not controlled. When taken from storage, temperature on these rounds ranged from 70°F during winter to ambient at other seasons. The temperature of the rounds was further affected by the length of time they remained at the gun before firing which varied from a few minutes to several hours.

Range Data

Figure 14 of Appendix (D) is a plot of uncorrected D/R versus rounds fired. The primed points on Figure 14 are D/R values for 5-round groups of burst firing. These data agree well with the cold-gun single-fire D/R values, although, three rounds fell short of the field of view of the cameras recording the ranges, indicating three wild rounds.

Barrel number 24583 fired with the non-picrite powder was distinctly inferior to barrel 24483 fired with the picrite powder in respect to range dispersion. In the former barrel range dispersion passed from a satisfactory to an unsatisfactory condition between 700 and 850 rounds. With some exceptions the latter barrel was reasonably satisfactory up to 1275 rounds. This contrasting behavior would be expected in view of the difference in forward bore wear in the two barrels. However, referring to Figures 3 and 4 of Appendix (A) a high percentage of spin loss would be expected in barrel 24583 after 774 rounds and in barrel 24483 after 980 rounds. The actual behavior of the latter barrel indicates that spin will be maintained with greatly reduced land height as long as the forward bore enlargement does not pass a critical dimension.

Bore photographs in conjunction with star-gauge results would permit more reliable evaluation of the rifling at various stages of gun life.

Temperature Rise of Cooling Water

The maximum temperature rise of the cooling water was 16°C, i.e., inlet temperature 26°, outlet temperature 42°.

CONCLUSIONS

As a result of the tests conducted it is concluded that:

The erosion rate near the origin of bore with cool non-picrite powder is substantially the same as with cool picrite powder. Using bore enlargement at the origin as a criterion, relative erosion rates are:

Standard M6 propellants	1.00
Cool Picrite propellants	0.21
Cool Non-picrite propellants	0.19

Erosion with the non-picrite propellant was restricted to a shorter section of the bore which may be caused by propellant differences or gun barrel differences influencing plate adhesion.

Forward bore wear with the cool non-picrite powder was more severe than with the cool picrite powder. This could be due to factors other than the powder difference, such as gun to gun variation.

Velocity uniformity with the cool non-picrite powder may be better than with the picrite powder, although statistical comparison is not possible with the data on hand. The uniformity was poor for both powders. Velocity measurements were possibly inaccurate due to a short base line for the velocity measuring solenoids and movement of the near solenoids due to muzzle blast.

The cool picrite and cool non-picrite powders do not have coincident velocity loss characteristics in worn guns. The fact that a common control powder was not used in these tests casts doubt on the validity of this conclusion.

Based on the range performance the life of the 3"/70 caliber gun Type C Mod 2 under rapid fire conditions is approximately 750 rounds with cool non-picrite powder and approximately 1300 rounds with cool picrite powder.

RECOMMENDATIONS

It is recommended that:

3"/70 caliber gun barrels Type C Mod 2 Serial No. 24483 and 24583 be subjected to metallurgical examination to determine if any differences exist which could account for the disparity in forward bore wear in the two barrels.

Additional gun firings be conducted with cool non-picrite powder to obtain additional wear data with this type of powder.

In future 3"/70 caliber gun firings, similar in nature to the test under consideration, a reference powder be fired in cold gun and hot gun erosion checks with the test powder.

When a reference powder has been established, firings be conducted with cool picrite and cool non-picrite type powders in conjunction with the reference powder to establish the velocity loss characteristics of the two powder types in worn guns.

REFERENCES

(a) BUORD ltr NP9 Re5a-FBW:fl of 3 July 1952
(b) BUORD Conf ltr Re5a-JWW:vl S74-1(3") Ser 40326 of 6 June 1952
(c) NPG Conf Report No. 1195

APPENDIX A

3"/70 CALIBER GUNS TYPE C-2 SERIAL NO. 24483 and 24583

RELATIVE EROSION UNDER RAPID FIRE CONDITIONS DUE TO COOL PICRITE AND COOL NON-PICRITE PROPELLANTS

BORE ENLARGEMENT AT ORIGIN vs. ROUNDS FIRED

Planned Firing schedule: 75 round programs in 15-round bursts with 5-second intervals between bursts

Planned Rate of Fire: 20 rounds per minute

U.S. Naval Proving Ground Dahlgren, Va.

Curve	Gun No.	Powder Index	Powder Type	Flame Temp. (°K)	Projectile
A	24483	Ex 6526 Ex 6527	Picrite	2065 2041	Ex. N
B	24583	Ix 84	Non-Picrite	1980	Ex. 11

BORE ENLARGEMENT AT ORIGIN (inches)

.120
.100
.080
.060
.040
.020
0

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400

ROUNDS

A

B

KEUFFEL & ESSER CO N Y

Figure 1

APPENDIX A

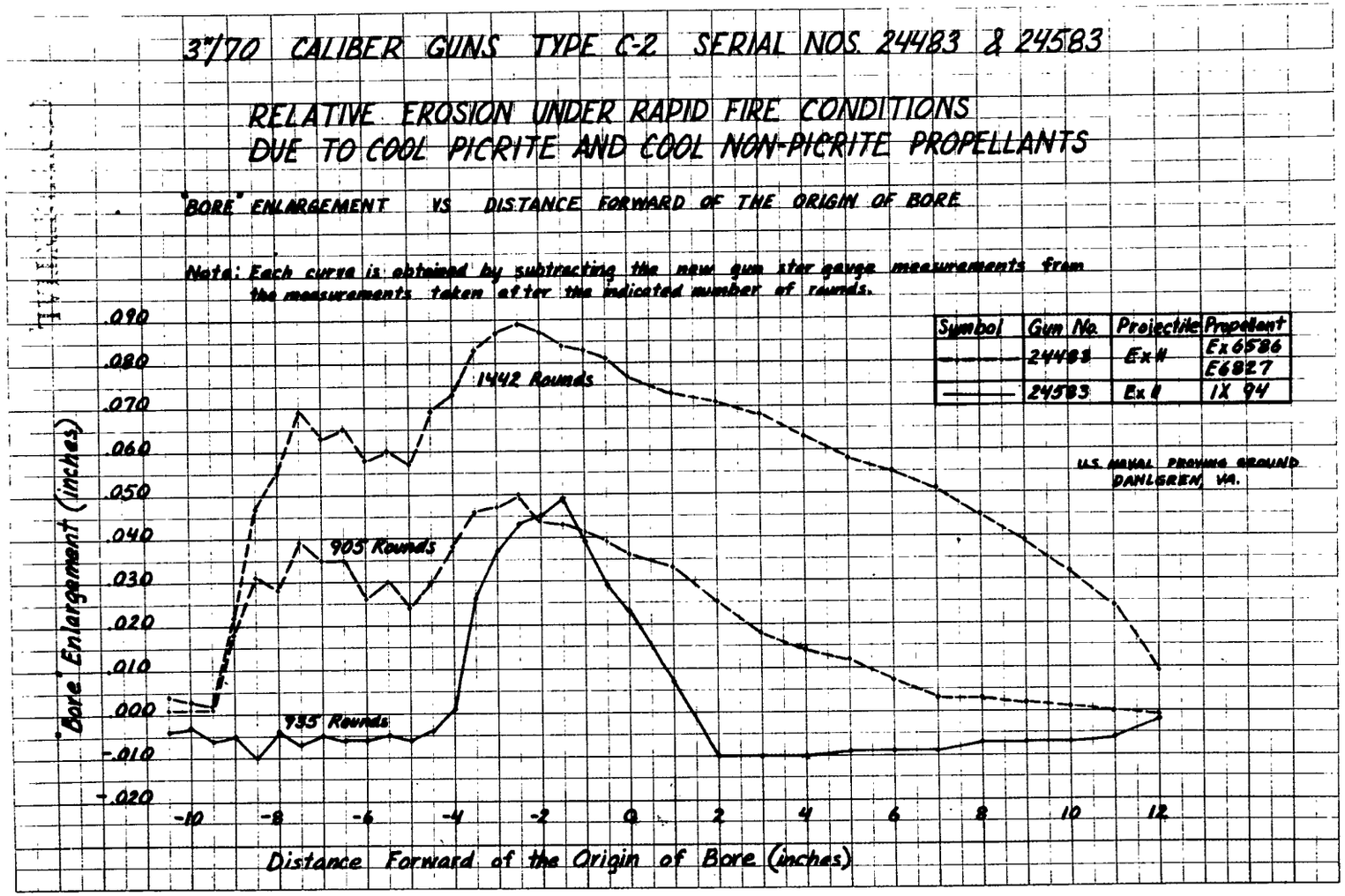


Figure 2

APPENDIX A

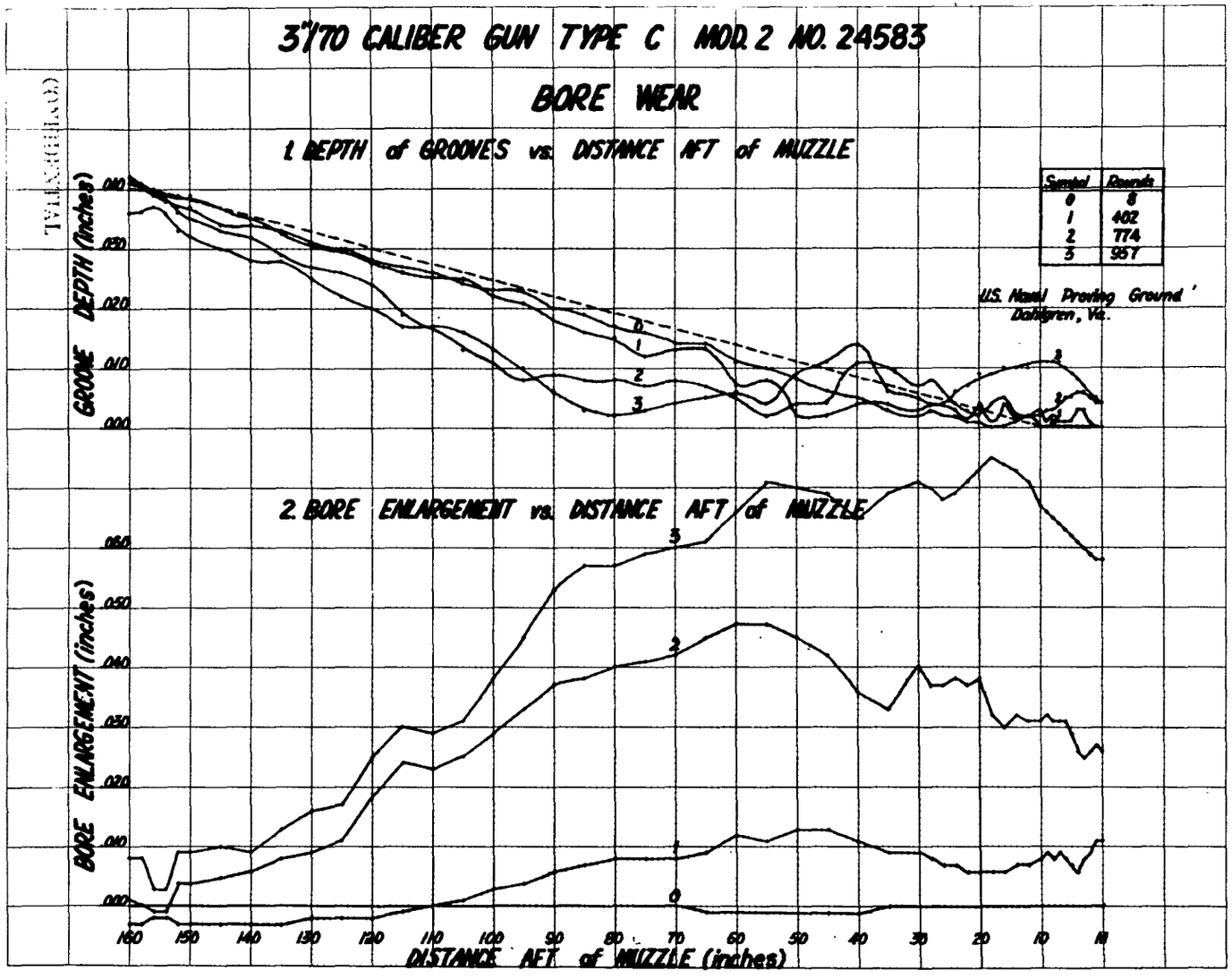


Figure 3

APPENDIX A

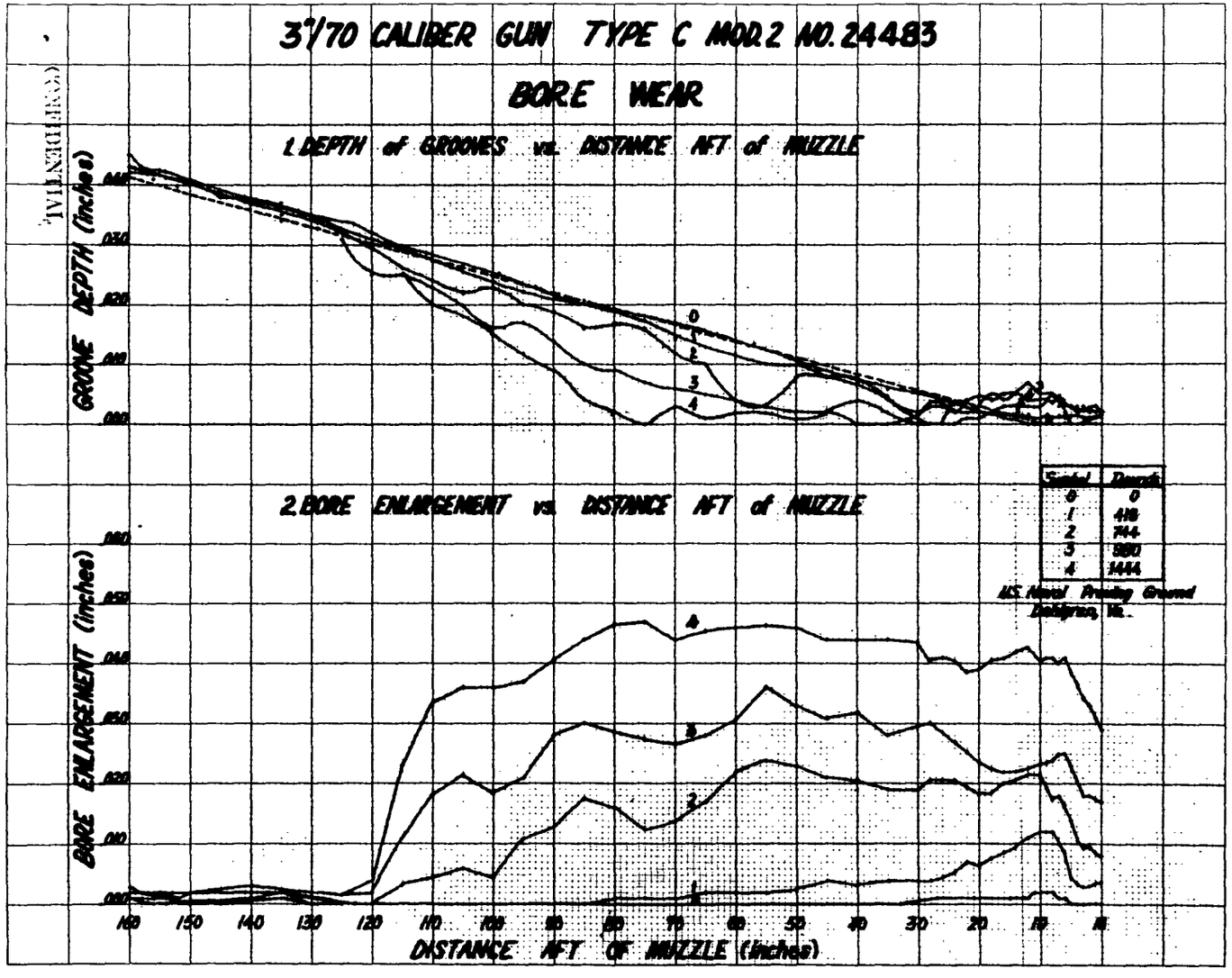


Figure 4

APPENDIX A

KUFFEL & ESSER CO. NEW YORK

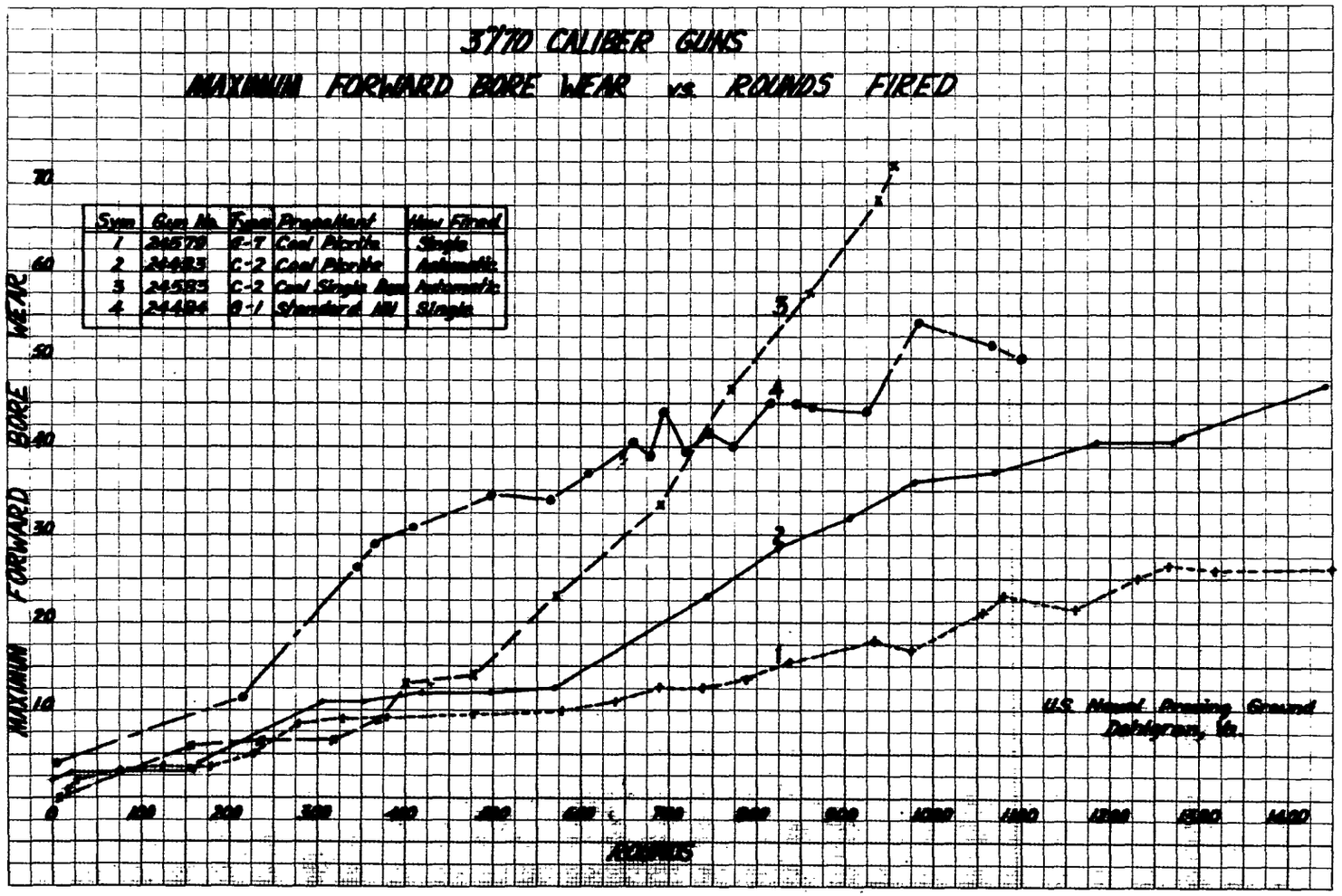
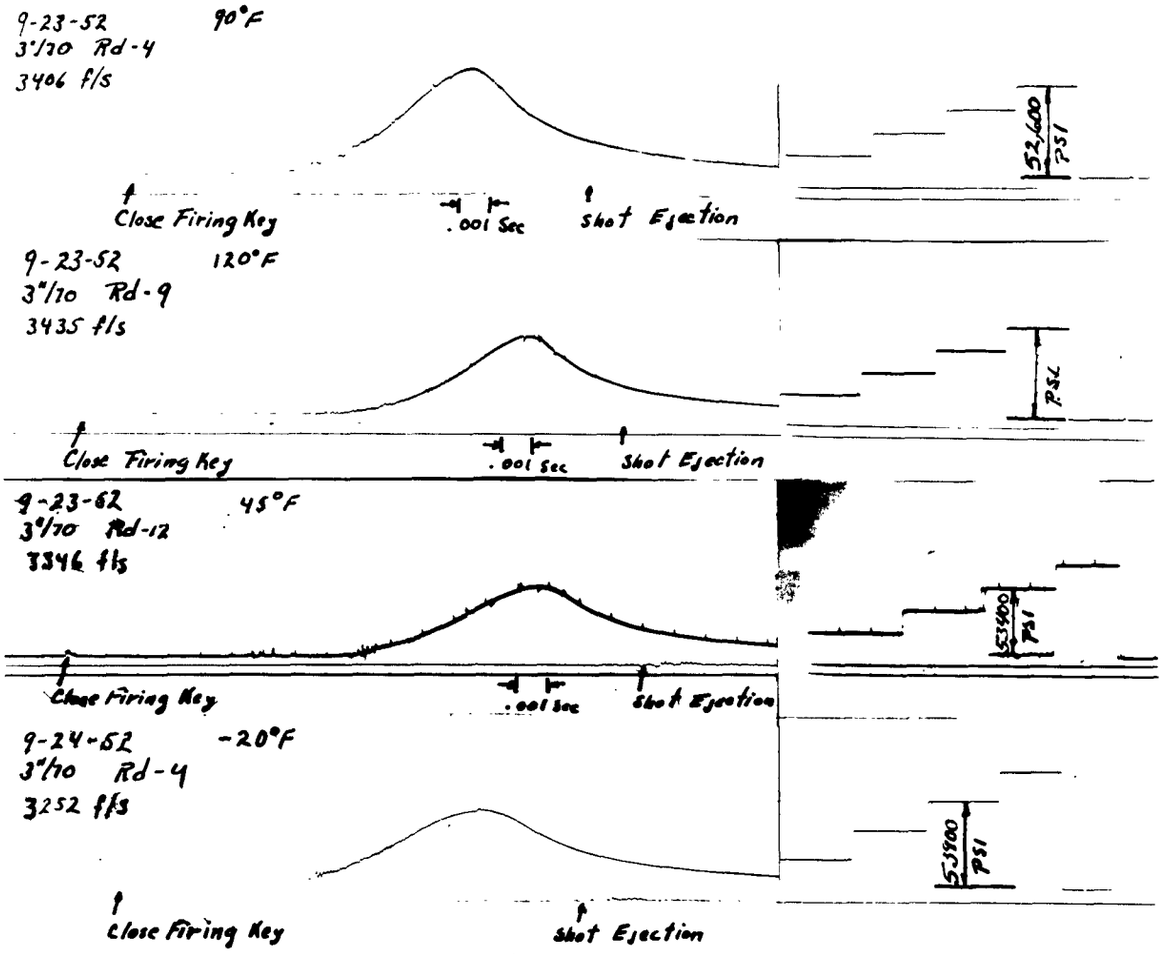


Figure 5

APPENDIX A

KEUFFEL & ESSER CO N Y

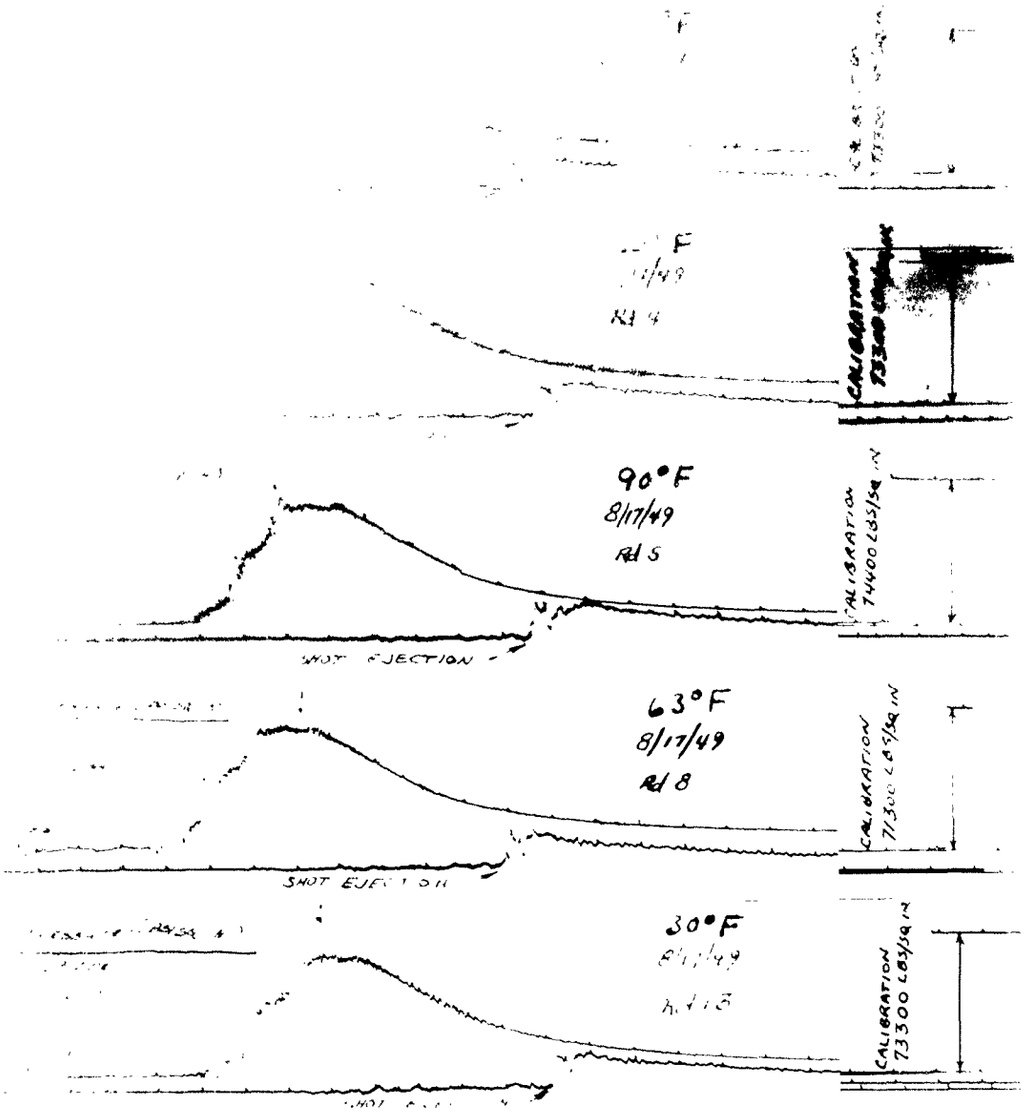
APPENDIX B



REPRESENTATIVE P-T CURVES OF POWDER LOT IX-94
in 3"/70 Caliber Gun Type G Mod 14 No. 24934

Figure 6

Appendix B


90°F
8/17/49
Rd 5
CALIBRATION
74400 LBS/SQ IN
SHOT EJECTION
63°F
8/17/49
Rd 8
CALIBRATION
73300 LBS/SQ IN
30°F
CALIBRATION
73300 LBS/SQ IN

APPENDIX C

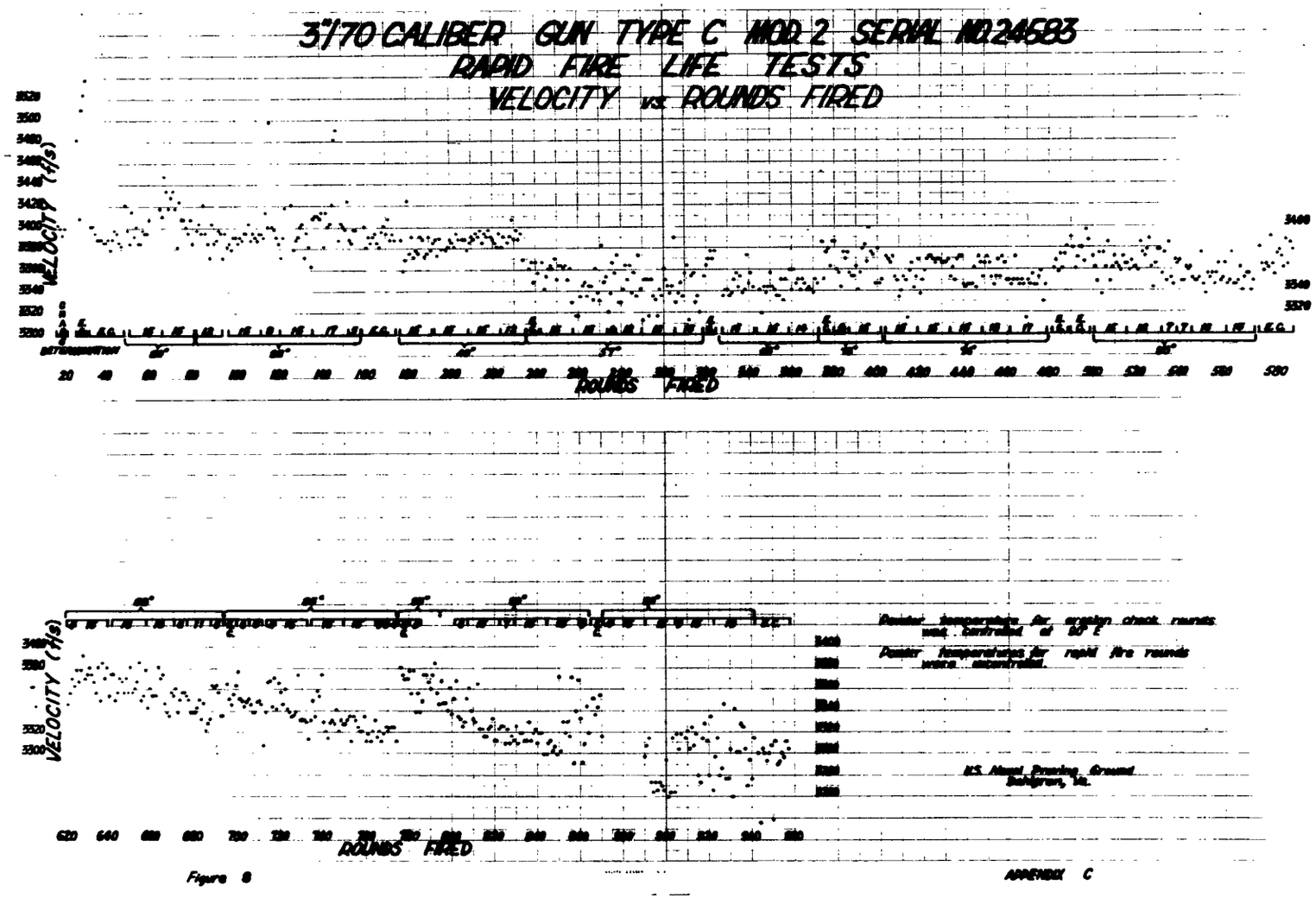

3"/70 CALIBER GUN TYPE C MOD 2 SERIAL NO 24683
RAPID FIRE LIFE TESTS
VELOCITY vs ROUNDS FIRED
VELOCITY (f/s)
ROUNDS FIRED
Powder temperature for erosion check rounds was controlled at 80° F
Powder temperatures for rapid fire rounds were uncontrolled.
U.S. Naval Proving Ground
Dahlgren, Va.

Figure 8

TABLE 1

VELOCITY VARIANCE

APPENDIX B

Barrel No. 24483

Type	Rounds	S^2	S	S^2*	S*	N**
E.C.	67-71	52.5	7.2	-	-	-
R.F.	72-119	93.0	9.6	-	-	-
R.F.	121-159	186.8	13.7	-	-	-
E.C.	162-166	287.5	17.0	-	-	-
R.F.	171-245	83.7	9.1	-	-	-
E.C.	274-278	20.3	4.5	-	-	-
R.F.	306-353	122.2	11.0	-	-	-
E.C.	355-359	115.8	10.8	-	-	-
R.F.	361-418	133.7	11.6	-	-	-
E.C.	420-424	3.6	1.9	-	-	-
E.C.	490-494	3.1	1.7	-	-	-
R.F.	497-515	88.7	9.4	-	-	-
R.F.	552-571	2296.4	47.9	155.4	12.5	6
R.F.	587-652	416.5	20.4	190.5	13.8	3
E.C.	663-667	839.3	29.0	OMIT	OMIT	5
R.F.	668-724	335.3	18.3	214.9	14.6	4
E.C.	746-750	139.4	11.8	-	-	-
R.F.	751-825	209.3	14.5	-	-	-
E.C.	827-831	71.8	8.5	-	-	
R.F.	833-906	398.7	20.0	260.0	16.1	6
E.C.	908-911	92.3	9.6	-	-	-
	917-979	291.8	17.1	-	-	-
E.C.	982-986	316.3	17.8	-	-	-
R.F.	997-1071	456.5	21.4	296.5	17.2	6
E.C.	1073-1077	349.3	18.7	-	-	-
E.C.	1079-1083	122.2	11.1	-	-	-
R.F.	1086-1112	417.1	20.4	356.5	18.9	1
R.F.	1114-1135	277.2	16.6	-	-	-
E.C.	1192-1196	38.1	6.2	-	-	-
R.F.	1197-1272	533.0	23.1	250.9	15.8	10
E.C.	1274-1278	192.5	13.9	-	-	-
R.F.	1280-1309	582.4	24.1	405.0	20.1	1
R.F.	1311-1344	194.9	14.0	-	-	-
E.C.	1356-1360	2 4.4	17.2	-	-	-
R.F.	1370-1444	276.4	16.6	-	-	-

Barrel No. 24583

N**	S*	S^2*	S	S^2	Rounds	Type
6	OMIT	OMIT	44.6	1990.0	26-31	E.C.
-	-	-	4.2	17.3	32-47	E.C.
-	-	-	13.1	171.5	51-80	R.F.
7	7.2	51.8	14.9	220.9	82-156	R.F.
-	-	-	7.1	50.1	160-174	E.C.
-	-	-	10.4	108.7	177-234	R.F.
-	-	-	10.3	107.3	237-241	E.C.
5	13.0	170.0	15.4	238.2	243-317	R.F.
-	-	-	5.3	28.3	319-324	E.C.
-	-	-	9.2	33.8	328-372	R.F.
-	-	-	16.3	264.4	374-379	E.C.
-	-	-	14.6	213.4	380-401	R.F.
-	-	-	14.3	107.6	404-478	R.F.
-	-	-	3.1	66.0	482-488	E.C.
-	-	-	10.6	113.2	490-498	E.C.
-	-	-	11.6	135.4	501-574	R.F.
-	-	-	11.6	136.5	577-592	E.C.
-	-	-	11.2	125.3	621-693	R.F.
-	-	-	6.9	47.9	695-699	E.C.
-	-	-	10.5	110.5	700-774	R.F.
-	-	-	4.0	16.1	776-780	E.C.
-	-	-	18.0	322.9	781-785	R.F.
9	9.1	82.9	17.0	288.5	802-362	R.F.
-	-	-	15.0	224.6	366-370	E.C.
15	13.5	182.7	23.1	533.3	891-941	R.F.
4	6.2	50.2	26.3	694.4	943-957	E.C.

* Statistically wild rounds omitted

** Number of rounds omitted

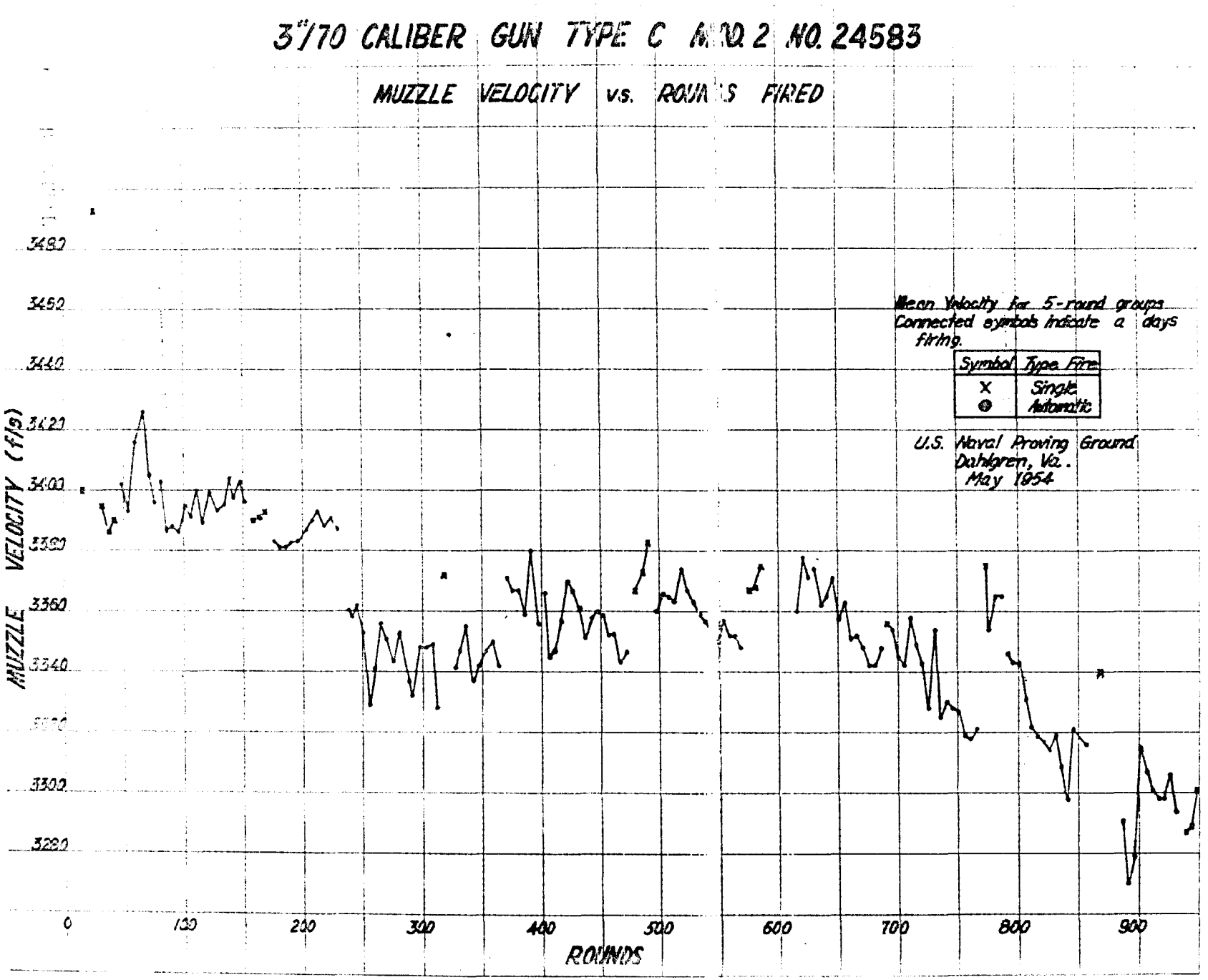

3"/70 CALIBER GUN TYPE C MOD 2 NO. 24583
MUZZLE VELOCITY vs. ROUNDS FIRED
MUZZLE VELOCITY (f/s)
3480
3460
3440
3420
3400
3380
3360
3340
3320
3300
3280
0
100
200
300
400
500
600
700
800
900
ROUNDS
Mean Velocity for 5-round groups
Connected symbols indicate a days firing.
Symbol | Type Fire
X | Single
● | Automatic
U.S. Naval Proving Ground
Dahlgren, Va.
May 1954

Figure 9

3"/70 CALIBER GUNS TYPE C-2
VELOCITY DATA
VELOCITY LOSS vs. BORE ENLARGEMENT AT ORIGIN

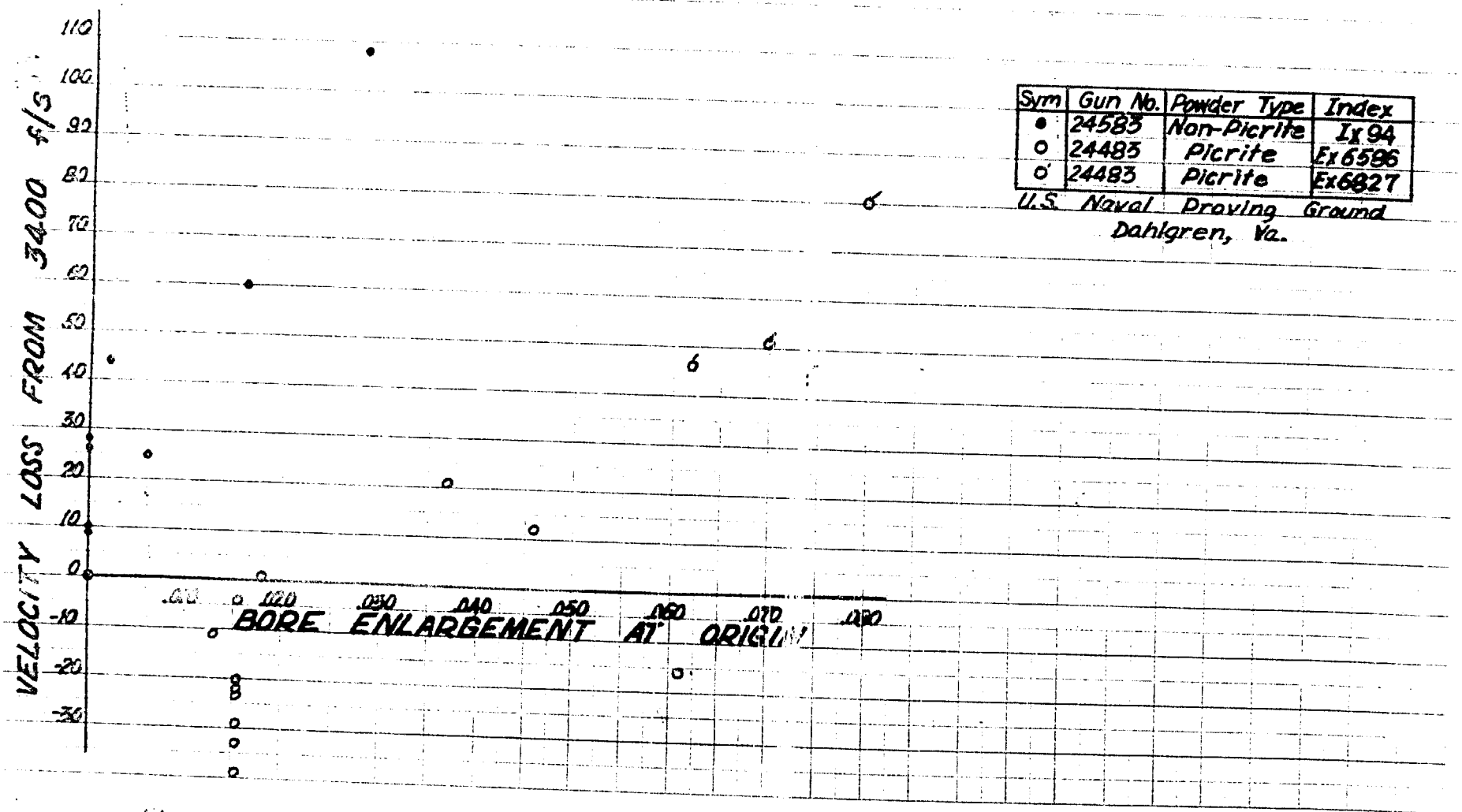


Figure 10

3"/70 CALIBER GUNS TYPE C-2

VELOCITY DATA

VELOCITY LOSS vs. EROSION GAUGE READING

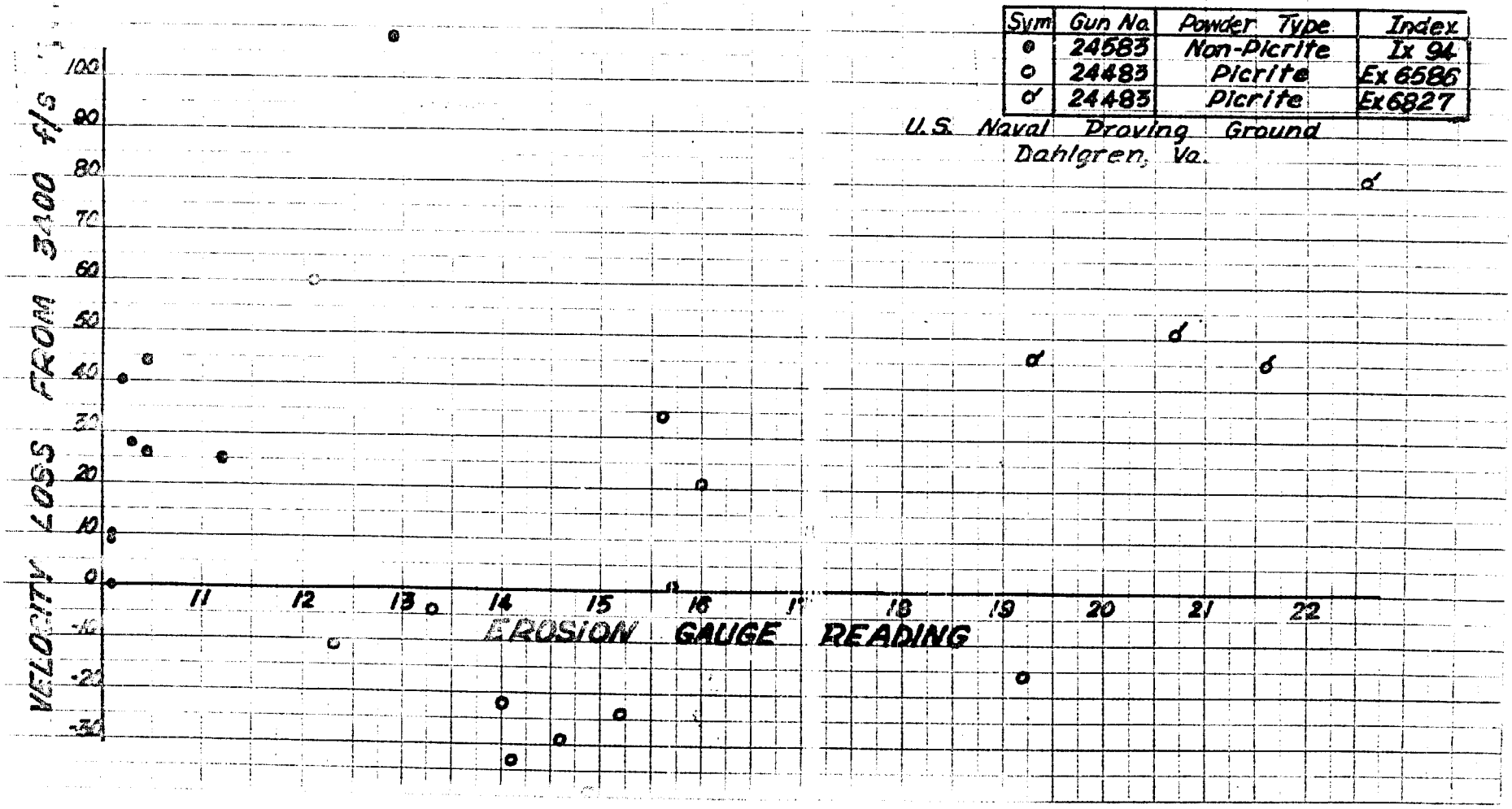


Figure 11

3"/70 CALIBER GUNS TYPE C-2

VELOCITY DATA

VELOCITY LOSS vs. ROUNDS FIRED

Sym	Gun No.	Powder Type	Index
•	24583	Non-Picrite	Ix 94
o	24483	Picrite	Ex 6586
o'	24483	Picrite	Ex 6827

U.S. Naval Proving Ground
Dahlgren, Va.

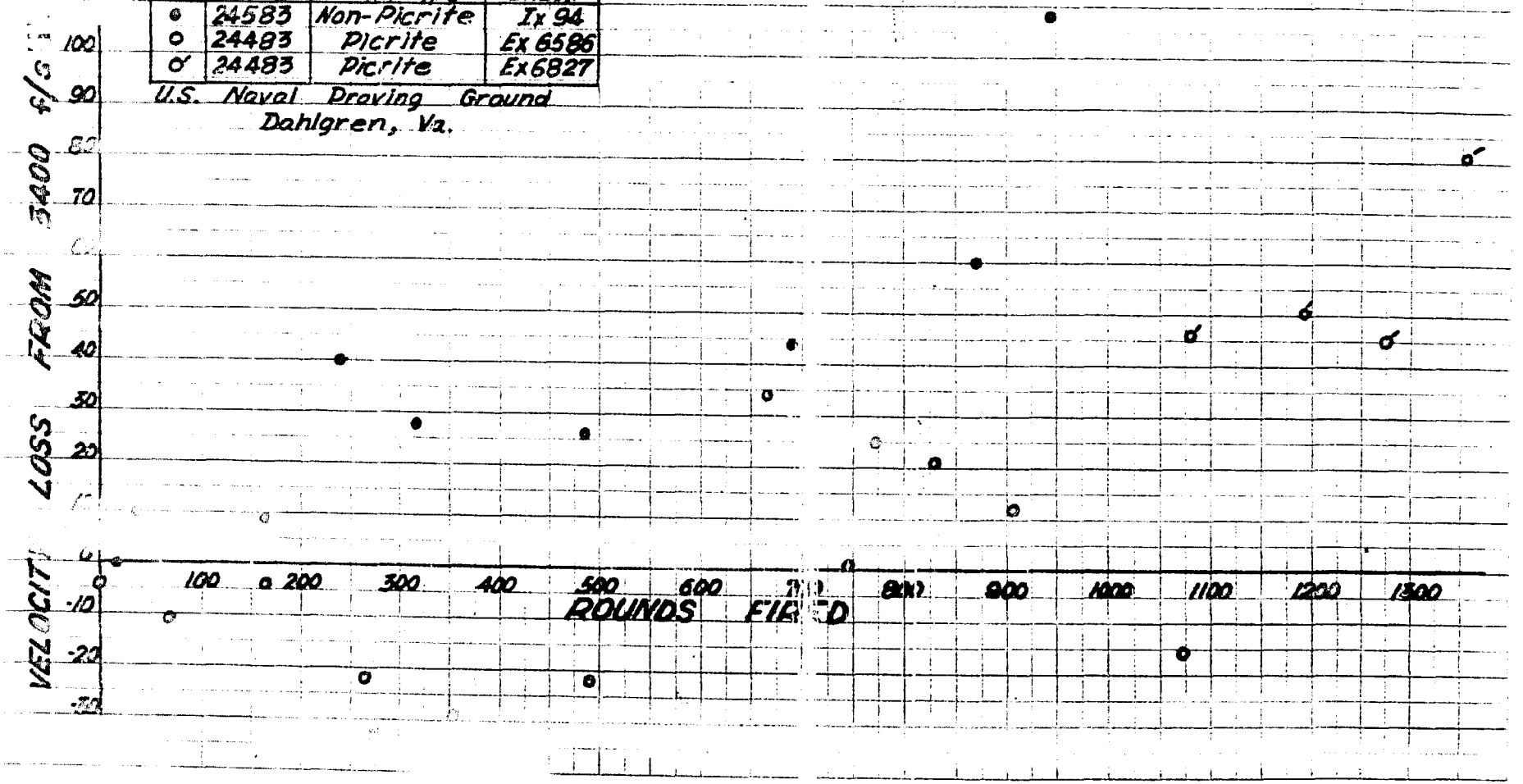


Figure 12

3"/70 CALIBER GUNS TYPE C-2

VELOCITY DATA

VELOCITY LOSS VS. BORE ENLARGEMENT AT ORIGIN PLUS MAXIMUM FORWARD BORE ENLARGEMENT

Sym	Gun No.	Powder Type	Index
○	[illegible]	[illegible]	Ix 94
○	[illegible]	PICATINNY	Ex 6586

U.S. Naval Proving Ground
Dahlgren, Va.

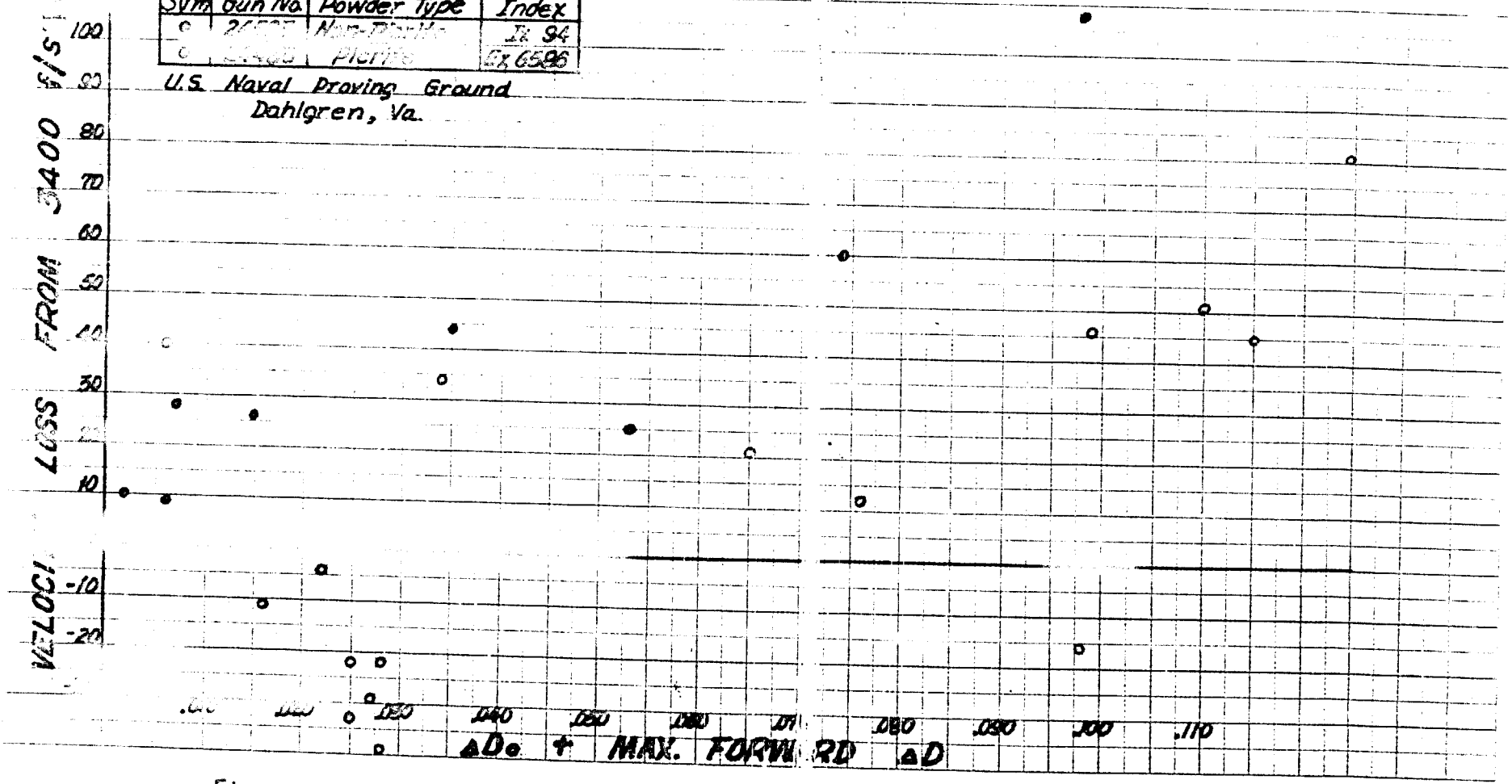


Figure 13

APPENDIX D

3"/70 CALIBER GUNS TYPE C MK 2 SERIAL NO 24483 and 24583

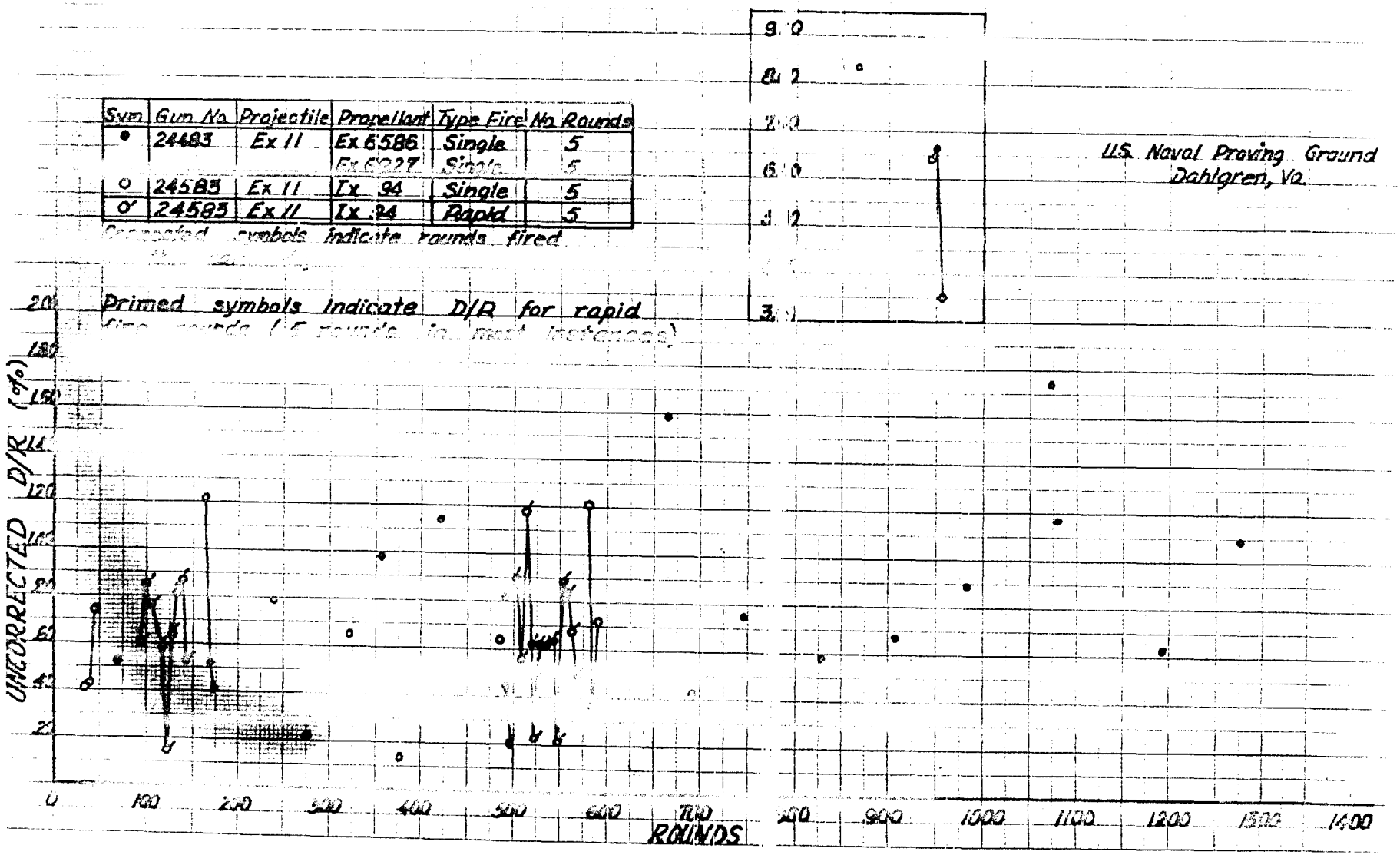
UNCORRECTED D/R vs ROUND NUMBER

Sym	Gun No	Projectile	Propellant	Type Fire	No Rounds
•	24483	Ex 11	Ex 6586	Single	5
			Ex 6827	Single	5
o	24583	Ex 11	Ex 94	Single	5
o'	24583	Ex 11	Ex 94	Rapid	5

Connected symbols indicate rounds fired

Primed symbols indicate D/R for rapid fire rounds (5 rounds in most instances)

U.S. Naval Proving Ground
Dahlgren, Va.



APPENDIX E

DISTRIBUTION

Bureau of Ordnance:

Ad3	1
Re2d	1
Re3b	1
Re5	1
Re5c	1
Re5e	1
Ad8	4

Armed Services Technical Information Agency
Document Service Center
Knott Building
Dayton 2, Ohio 5

Commanding General
Aberdeen Proving Ground
Aberdeen, Maryland
Attn: Technical Information Section
Development and Proof Services 1

Commander, Operational Development Force
U. S. Atlantic Fleet, U. S. Naval Base
Norfolk 11, Virginia 1

Naval Gun Factory 1

Naval Powder Factory 1

Watertown, Arsenal
Watertown, Massachusetts 1

Solid Propellants Information Agency
Applied Physics Laboratory
Johns Hopkins University
Silver Spring, Maryland 1

Catholic University of America
7th St. and Michigan Ave. N.E.
Washington 17, D. C.
Attn: Dr. F. O. Rice 1

Local:

OMG	1
OMIV	1
File	1

Subject: Rapid Fire Life Test of 3"/70 Caliber Gun Barrel Type C Mod 2 Serial 24583 With Cool Non-Picrite Powder by M. L. Hunt, Armament Department, U. S. Naval Proving Ground, Dahlgren, Virginia

21 July 1954

ABSTRACT

A rapid fire life test has been conducted in 3"/70 caliber gun Type C Mod 2 Serial No. 24483 employing a cool double base picrite propellant. The results of this test were reported in reference (c). The Bureau of Ordnance has directed that a similar test in a similar barrel employing a cool single base non-picrite propellant be conducted in order to establish the relative erosion rate for the two propellants. 3"/70 Caliber gun Type C Mod 2 Serial No. 24583 was used in this latter test.

The planned firing program consisted of five 15-round bursts with five second interval between bursts. The rate of fire was to be 90 rounds per minute. Barrel No. 24583 was fired a total of 957 rounds. At that time asymmetric forward bore wear had developed to such an extent that further firing was not deemed advisable.

The wear rate near the origin of bore with cool non-picrite powder closely approximates that with cool picrite powder. The forward bore wear in barrel No. 24583 (fired with cool non-picrite powder) was much more severe than in barrel No. 24483 (fired with cool picrite powder). The cause of the disparity in forward bore wear cannot be resolved at this time. Conceivably the propellant composition could be a contributing factor. Metallurgically one barrel may differ from another sufficiently to cause considerable variations in barrel wear. In both barrels forward bore wear was more severe than has been experienced in the 3"/70 Caliber Gun Type G Mod 7 under single fire conditions.